UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SUMMARY REVIEW OF MONTHLY REPORTS[1]
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EROSION CONTROL PRACTICES DIVISION

Increased Potato Yields from Crop Rotation and Supplemental Irrigation - O. R. Neal, New Brunswick, N. J.

"Yields during 1951 from the potato rotation and irrigation plots were shown in an earlier report. A summary of yields from these plots for the past 5 years has recently been prepared. The data are shown below:

Table 1.--The influence of crop rotation and supplemental irrigation on potato yields

| Cropping system | Yield - Bu./A. | | % increase for irrig. (all rotations) |
|---|---|---|---|
| | Irrigated | Not irrigated | |
| **5-YEAR AVERAGE 1947 THROUGH 1951** | | | |
| Continuous potatoes | 281 | 244 | |
| 2-yr. potatoes and wheat | 324 | 270 | 15 |
| 3-yr. potatoes, wheat, clover | 315 | 282 | |
| **4-YEAR AVERAGE OMITTING 1949** | | | |
| Continuous potatoes | 283 | 278 | |
| 2-yr. potatoes and wheat | 318 | 307 | 0 |
| 3-yr. potatoes, wheat, clover | 309 | 319 | |
| **1949 YIELD** | | | |
| Continuous potatoes | 270 | 111 | |
| 2-yr. potatoes and wheat | 352 | 121 | 161 |
| 3-yr. potatoes, wheat, clover | 342 | 136 | |

"Yield increases from the improved crop rotations have not been as great with potatoes as has been the case with tomatoes and sweet corn in similar studies. Tomato yields have been increased 34 percent and sweet corn 46 percent with good rotations as compared with continuous cultivation. Potato yields have shown increases varying from 10 to 20 percent under similar conditions. This is due, at least in part, to the intensive cultivation and heavy tractor and sprayer traffic in potato fields. The improvement in soil structure resulting from the good rotations tends to disappear rapidly under the compacting influence of this traffic.

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"As an average for the 5-year period, supplemental irrigation has increased yields by 15 percent. The second and third sections of the above table indicate, however, that all of this increase came during the 1949 season. In this year, yields from all cropping systems were more than doubled by irrigation. No appreciable increase occurred during the other 4 years. At present production costs for potatoes, the use of irrigation in 1949 doubtless would have made the difference between a reasonable profit and a very serious loss on the crop. If a growing season such as the 1949 one is to be expected once in 5 years, it is possible that the maintenance of irrigation equipment even for such infrequent use might be economically sound.

Increased Yields from Water-Loss Reduction - D. D. Smith, Columbia, Mo.

"Large reductions in water loss were secured during 1951 by good crop and soil management methods. The water loss from a corn-oats rotation without soil treatment was 2.7 times that for the same rotation with ample soil treatments and sweetclover. With 8.2 inches of additional water retained by the soil for crop production and which was prevented from reaching flooding streams, the plots with the improved soil-physical condition and higher fertility level produced 85 additional bushels of corn per acre and 23 additional bushels of oats per acre."

Wheat Yields from Various Tillage and Residue Treatments - F. H. Siddoway, St. Anthony, Idaho

"The yields for the various initial and preparatory methods of preparing summer fallow this year are not consistent with some of the past years. Generally speaking, the plows follow the same order as the 8-year average with the moldboard first, sweeps second, and one-way disk last. The modified moldboard is 0.2 of a bushel higher than the offset disk for the 8-year period but for the crop year 1951 the offset is 0.7 of a bushel higher than the modified moldboard. The difference in yield between the high and low plows for the 8-year period is only 1.4 bushels and the greatest difference between any two preparatory tillage treatments is only 0.6 of a bushel.

Table 1.--Yield of winter wheat in bushels per acre for various tillage and residue treatments for 1951 crop year

| Type plow | Stubble burned | Stubble utilized | | | | Plow average |
|---|---|---|---|---|---|---|
| | | Subsoil fall | Spring disk | Fall disk | Rod-weed when necessary | |
| Moldboard | 27.3 | 30.0 | 28.4 | 26.0 | 27.8 | 27.9 |
| One-way disk | 23.3 | 25.2 | 25.2 | 25.0 | 27.7 | 25.3 |
| Mod. moldboard | 25.5 | 26.3 | 26.3 | 23.4 | 26.5 | 25.6 |
| Sweeps | 27.8 | 27.7 | 28.4 | 26.0 | 28.4 | 27.7 |
| Offset disk | 25.2 | 25.7 | 26.0 | 26.7 | 28.0 | 26.3 |
| Preparatory Tillage Ave. | 25.8 | 27.0 | 26.9 | 25.4 | 27.7 | |

"This year as in some of the past years rodweeding only when necessary averaged higher than any other stubble treatments. Soil moisture and climatic relationships some years favor additional working of the soil as reflected in crop yields while in other years the opposite is true. Some times tillage

practices that favor nitrate production are best while in others, practices that favor moisture retention give higher yields. If erosion were not a factor there would be little evidence to support the recommended use of any one tillage method over another. The difference in yield resulting from utilizing the straw on the surface and turning it under or burning is insignificant."

Table 2.--Yield of winter wheat in bushels per acre for various tillage and residue treatments for 1944-51

| Type plow | Stubble burned | Stubble utilized | | | | Plow average |
|---|---|---|---|---|---|---|
| | | Subsoil fall | Spring disk | Fall disk | Rod-weed when necessary | |
| Moldboard | 33.8 | 34.9 | 33.8 | 34.1 | 33.4 | 34.0 |
| One-way disk | 33.5 | 32.0 | 32.0 | 32.6 | 33.1- | 32.6 |
| Mod. moldboard | 33.2 | 33.4 | 33.2 | 32.8 | 33.8 | 33.3 |
| Sweeps | 33.4 | 33.9 | 33.7 | 34.1 | 33.4 | 33.7 |
| Offset disk[1] | 33.6 | 32.2 | 32.1 | 34.4 | 33.4 | 33.1 |
| Preparatory tillage ave. | 33.5 | 33.3 | 33.0 | 33.6 | 33.4 | |

[1]Previous to 1950 this treatment was rod-weeded immediately after plowing.

Increased Yields from Mulch Planter and Fertilizer Applications - F. W. Schaller, Ames, Iowa

"The IHC mulch planter for corn was used in experiments at Clarinda again this year. Tests were conducted on both sod and corn-stubble land. Direct comparisons were made with the conventional method of planting corn and in addition different methods of applying nitrogen fertilizer were studied.

"The 1951 growing season was characterized by excessive rains in May and June and above normal rains throughout the summer and fall. Below normal temperatures occurred consistently. The corn was not planted until June 13 and 14 because the mulch planter was received late and the frequent rains caused further delay. Plowing, tillage, and planting operations were accomplished when the soil was too wet. Heavy rains also occurred just after planting. These factors caused considerable variation in stands and yields, and undoubtedly affected the response to tillage methods and methods of fertilizer application.

"The following general conclusions are evident from the results obtained in 1951:

1. Corn yields for all treatments averaged 9 bushels per acre higher on unplowed ground (mulch planter) than on plowed ground. Greater soil stirring and compaction in the case of plowing was probably harmful this year with the wet soil conditions which prevailed during land preparation and planting.

2. The greatest response to nitrogen (40 lbs. N per acre) occurred where the nitrogen fertilizer was placed deep with the mulch planter or by plowing down. The average yield increase from deep-placed nitrogen was 13 bushels per acre. Side-dressed nitrogen gave an average increase of 5 bushels per acre. The late application of the side-dressed nitrogen (July 25) may have been responsible for its poor response.

3. In most treatments on first-year corn, starter fertilizer (75 lbs. per acre 4-16-0) gave a large increase in yield. The average increase was 8 bushels per acre. The starter fertilizer also increased the effectiveness of the nitrogen fertilizer. On second-year corn highly significant increases were obtained with starter fertilizer, but the increases were lower and more variable than with corn on sod ground. The average increase for all treatments on second-year corn was 6 bushels per acre.

4. Observations throughout the season showed that on unplowed ground the mulch planter plus three cultivations effectively killed all existing vegetation and controlled weeds. Furthermore, with this treatment all plant residues remained on or near the soil surface and gave very effective protection from erosion during the heavy June rains."

Increased Production from Pitted Pastures - O. K. Barnes, Laramie, Wyo.

"The pitted pastures at Archer were continued under experimental grazing through 1951. Four pastures are in this group and include two that were pitted in 1942 and two nontreated check pastures. This past year completed 10 years of grazing. For the 10 years, the two pitted pastures carried 34 percent more sheep per acre and produced a total of 90+ pounds more lamb per acre than did the two adjoining nontreated pastures. Even with this heavier grazing and greater meat production, the pitted pastures had over 50 percent more grass left at the end of each season than did the check pastures. In the 10th year, 1951, the pitted pastures carried 29 percent more sheep and produced 9 pounds more lamb per acre than did the check pastures."

Increased Yields from Sweet-Clover Rotation - F. L. Duley, Lincoln, Nebr.

"Grain crops have been very greatly increased by the use of sweet clover in the rotation. It has been found that oats can follow 2 years sweet clover and produce high yields due to the increased supply of available nitrogen. So far no trouble has been encountered due to lodging. The yields in these tests have been about three times as high as on land that has had no legume during the last 13 years. The effect of a legume like-sweet clover is noticeable for at least 3 years. The effect of annual legumes seeded with oats has been greater on the following corn crop than on the oats.

"Although table 1 will show a slightly greater value of crops produced on the plowed land than on the subtilled land the great difference is due to the legume. The difference due to tillage method is small by comparison. Furthermore, this difference may be considered as the charge against greatly improved soil conservation. In the long run it might easily be worth much more than this difference especially when the system under subtillage is in itself a highly profitable one."

Table 1.--The effects of 2 years sweet clover on yields and value of grain crops following are shown below. The rotation was sweet clover 2 years, oats, wheat, corn

| Crop[1] | Tillage | Yield - Bu. per A. After sw. clover | Yield - Bu. per A. No sw. clover | Increase yield Bur. per A. | Increase yield Percent | Value of crop After sw. clover | Value of crop No sw. clover |
|---|---|---|---|---|---|---|---|
| Oats | Subtilled | 60.1 | 28.0 | 32.1 | 115 | $45.05 | $21.00 |
| | Plowed | 65.3 | 27.8 | 37.5 | 135 | 48.98 | 20.85 |
| Wheat | Subtilled | 35.1 | 24.9 | 10.2 | 41 | 78.97 | 56.02 |
| | Plowed | 35.5 | 26.0 | 9.5 | 37 | 79.87 | 58.50 |
| Corn | Subtilled | 74.5 | 48.4 | 26.1 | 54 | 111.75 | 72.60 |
| | Plowed | 79.1 | 50.3 | 28.8 | 57 | 118.65 | 75.45 |
| | Total Value Crops - 3 years | | | | | | |
| | Subtilled | | | | | 235.80 | 149.62 |
| | Plowed | | | | | 247.50 | 154.80 |
| | Increased value due to S. Clover - 3 years | | | | | | |
| | Subtilled | | | | | 86.18 | - |
| | Plowed | | | | | 92.70 | - |
| | Increase - Plowing over subtilled | | | | | | |
| | | | | | | 6.52 | |
| | | | | | | Per year 2.17 | |

[1]Results with oats based on 6 years, wheat 5 years, and corn 3 years tests.

Effect of Seedbed Preparation on Rate of Legume Seeding and on Grain Yield - O. E. Hays, LaCrosse, Wis.

"The highest yearly soil losses from 1943-51 occurred from field planted to grain. The average yearly soil losses from grain for this 9-year period are 3.6 times greater than they are from corn. Table 1 gives data on soil losses from grain and corn in a 5-year rotation for the period 1943-51. This table appears on the next page.

"General field observations have indicated that soil losses from grain fields vary according to the roughness of the seedbed. Soil losses have been higher from those grain fields having the soil broken down to a fine degree by several workings during the seedbed preparation than they have been from those having a higher percentage of coarse clods due to fewer workings at this time. Little information has been available on the effect of fineness of seedbed on the rate of seeding required to obtain a satisfactory stand, or whether or not a higher rate of seeding was necessary to obtain a satisfactory stand on a rough seedbed.

"In 1950, a half-acre field at the LaCrosse Soil Conservation Experiment Station was divided into two equal sections for seedbed preparation. One section was

worked twice with the 4-section harrow, only enough to prepare a seedbed. The other section was double-disked and smoothed with the harrow, leaving an intermediate and a fine seedbed, respectively. Each section was divided into three subsections which received legume seeding at 5, 10, and 15 pounds per acre, respectively. These subsections were further subdivided into three sections, with one section being dragged after seeding, one cultipacked, and one rotary-hoed. All operations were carried out on the contour.

Table 1.--Soil losses from corn and grain
1943-51

| Year | Corn | | Grain | |
|---|---|---|---|---|
| | Severe erosion | Moderate erosion | Severe erosion | Moderate erosion |
| 1943 | 0.18 | 0.10 | 0.56 | 0.14 |
| 1944 | 2.08 | .72 | 4.09 | 2.60 |
| 1945 | .41 | 1.17 | 24.60 | 23.34 |
| 1946 | 1.55 | .52 | 5.99 | 6.40 |
| 1947 | 4.75 | 3.17 | 8.32 | 1.71 |
| 1948 | .02 | .28 | 3.27 | 3.12 |
| 1949 | .24 | .52 | 13.90 | 17.80 |
| 1950 | 21.71 | 21.17 | 52.69 | 56.48 |
| 1951 | 7.46 | .12 | 5.22 | 2.62 |
| Average | 4.27 | 3.08 | 13.18 | 12.69 |

Corn and spring grain in 5-year rotation; soil loss - tons per acre (annual losses).

"Results of stand counts made the year of seeding showed no great spread in the number of legume plants per square foot between any of the treatments involved. The average number of legume plants for all treatments was about 6 per square foot. Where a 15 pounds per acre seeding rate was used, on both the fine and intermediate seedbeds and applied with a drag seeder, the highest number of plants per square foot was obtained. The cultipacker gave a lower number of plants per square foot, on both the intermediate and fine seedbeds, than did either of the other seeding methods.

Table 2.--Effect of rate of seeding and seedbed preparation on legume establishment

| Method of covering | Rate of seeding, per acre | | | | | | Average |
|---|---|---|---|---|---|---|---|
| | 5# | | 10# | | 15# | | |
| | Intermed. seedbed | Fine seedbed | Intermed. seedbed | Fine Seedbed | Intermed. seedbed | Fine seedbed | |
| | Alfalfa plants per square foot | | | | | | |
| Drag | 7 | 5 | 6 | 7 | 8 | 8 | 7 |
| Cultipacker | 5 | 5 | 6 | 6 | 5 | 7 | 6 |
| Rotary hoe | 5 | 4 | 6 | 6 | 6 | 8 | 6 |
| Average | 6 | 5 | 6 | 6 | 6 | 8 | 6 |

"The effect of the degree of fineness of seedbed on yield of grain was observed this year. Three fall plowed areas were seeded as follows: (1) seeded without any additional working, (2) seeded after being worked twice with field cultivator, (3) seeded after working three times with field cultivator. The yields were 68.0, 87.1, and 76.2 bushels per acre, respectively. Legume stand counts will be made on all three areas during the spring of 1952.

"These results indicate that the intermediate type of seedbed is probably better from a yield standpoint and from the standpoint of obtaining satisfactory legume stands, and that the fine, erodible type of seedbed is not desirable for either obtaining better stands or for runoff and erosion control. Additional years of data are needed to obtain an adequate sample of weather and soil conditions."

Corn Yields from Mulch Tillage - O. W. Beale, Clemson, S. Car.

"Yields of corn from the mulch-tillage test are not significantly different for all methods used in 1951. The mulch system produced yields slightly higher than the plowed cover-crop method for both cover crops of crimson clover and vetch and rye. The rainfall during the corn growing season was poorly distributed. A spring drought period extended from April 22 to June 3, during which 0.49 inch of rain occurred, about 10 percent of normal. Another drought period occurred from June 13 to July 19 when 1.44 inches of rain were recorded.

"The runoff and soil losses during the corn-growing season from the cover-crop treatments, both mulched and plowed, increased over those for 1950, however, the total rainfall for this season was almost normal. Several of the rains were very intense and high runoff and soil losses resulted from single rain storms."

Yields from Supplemental Irrigation - G. R. Free, Ithaca, N. Y.

"In our irrigation work on potatoes and pasture at the Arnot, we are with some treatments shooting at the production ceiling with no strings attached to us except the inherent limiting characteristics of the soil and site, the climatic factors other than rainfall deficiency, and of course, our own limitations as diagnosticians. These studies are located on Mardin silt loam, land-capacility classes II or III at about a 1,900-foot elevation.

"A total production of 4.0 tons per acre of grass (oven dry basis) was reached in 1951 with natural rainfall and 4.3 tons per acre with irrigation. Potato yields over the past 6 years have ranged from 323 to 535 (average 389) bushels per acre with natural rainfall and 372 to 565 (average 436) bushels per acre with irrigation.

"These yields show that the ceilings imposed by natural factors not subject to control are high at the Arnot--how high we probably don't know yet. The addition of supplemental water by irrigation for the most part has not raised the ceilings greatly over the period although we can look back into past years at the Arnot--say 1939 and 1941--when water was probably the limiting factor. It seems certain, however, that supplemental water will not be needed at the Arnot to the same extent and as often as it is in some parts of the State. One or two dry years, however, could change the irrigation picture at the Arnot."

Seed-Cotton Yields from Tillage Methods - O. W. Beale, Clemson, S. Car.

"Yields of cotton from the cotton-mulch test for the past 4 years indicate a definite decline in yield from the continuous cotton plots and an increase from the mulch-tilled plots. The yields from the plowed cover-crop plots have slightly exceeded the mulch-tilled plots during this period.

"The cotton is grown in a 4-year rotation of wheat and Kobe lespedeza-cotton-wheat and Kobe lespedeza-corn. The disk harrow and the field tiller are used to prepare the mulch land, utilizing the residues from the preceding wheat and lespedeza as sources of mulch for the cotton crop. The plowed, clean-cultivated plots, including cover crop and continuous cotton plots, are prepared with the disk plow and disk harrow. All plots are planted and cultivated with conventional implements.

"Table 1 gives the yields of seed cotton for the years 1948-51 from the three tillage methods. The average annual yield from the mulch test has increased 21 percent during this period; the plowed cover-crop plots 4 percent and the plowed continuous cotton has decreased 25 percent. Yield decreases in 1951 were probably due to moisture deficiencies during April, May, and June when from April 26 to June 3 the rainfall was 0.49 inch. Approximately one-third of the stand was obtained in early May and the remainder of the cotton seed germinated to a good stand in June. There was no apparent differences in germination in the cover-crop plots, but the continuous cotton appeared to germinate more slowly."

Table 1.--Yields of seed cotton from cotton-wheat-Kobe lespedeza rotation

| | | Yields of seed cotton, lbs./acre | | | | |
|---|---|---|---|---|---|---|
| | | 1948 | 1949 | 1950 | 1951 | Average |
| Mulch, disk harrow, field tiller | Wheat, Kobe lespedeza | 1,235 | 1,641 | 1,512 | 1,347 | 1,434 |
| Plowed, clean cultivated | Wheat, Kobe lespedeza | 1,549 | 1,741 | 1,718 | 1,390 | 1,600 |
| Plowed, clean cultivated | Cotton | 1,286 | 1,026 | 978 | 890 | 1,045 |
| Difference required for significance | | 265 | 355 | 415 | 450 | |

Results of Organic Matter and Nitrogen Determinations - J. Vincente-Chandler, Rio Piedras, Puerto Rico

"The results of organic matter and nitrogen determinations on the 65 soil samples taken during the survey of the coffee region have been reported. These data indicate that organic matter and nitrogen can be built up and maintained at high levels in the soil on steep slopes under coffee. Over one-third of the soils studied had more than 5 percent organic matter in the upper 6 inches with some as high as 8 percent. Soil samples taken from small areas of virgin forests in the coffee region during the survey, had up to 10 percent organic matter. The C/N ratio for almost all the samples was in the vicinity of 10:1. The relatively high rainfall (80 inches and above), minimum cultivation, relatively low soil temperatures brought about by altitude and shade, and the nitrogen supplied by the leguminous shade trees, all undoubtedly contribute to the maintenance of these high levels of soil-organic matter.

"Organic matter and nitrogen determinations were run on soil samples taken from the handmade cliff terraces at Utuado. When the terraces were constructed about 3 years ago they consisted largely of subsoil with virtually no organic matter. Since then they have received several applications of a complete fertilizer. Terrace number one was planted to clean-cultivated crops for a year and then received a heavy application of 'cachaza.' Since then it has been in Velvet Beans. Soil samples taken from the upper 2 inches show that the soil has an organic-matter content of about 3.5 percent and about 0.25 percent nitrogen. Terrace number two differs from number one only in that it received no 'cachaza' and that Kudzu instead of Velvet Beans has been growing on it for the last 2 years. The soil in this terrace has about 1 percent organic matter in the surface 2 inches. The mass addition of 'cachaza' probably accounts for most of the difference in the organic-matter content of the soil of both these terraces 2 years after its application. The nitrogen supplied by the Velvet Beans probably helped to maintain the high level of organic matter. These data leave little doubt that organic matter can be rapidly built up even in these sandy soils if they are properly managed.

"Samples were taken of the upper 6 inches of soil in the Kudzu and Molassesgrass pastures at Orocovis. They show that the organic-matter content of this Mucara clay soil has risen somewhat during the last 2 years and now averages about 3 percent. In nearby areas where the pasture has not been cut or grazed for 3 years the soil organic-matter content is only about 2.5 percent. This may be at least partly explained by the fact that less organic matter has been added to the soil than if the pastures had been grazed. The small experimental plots from which the forage has been cut and removed periodically are being sampled to determine the effect of this type of management on the organic-matter content of the soil.

"Samples taken from a level field of alluvial soil which has been in Kudzu and Molassesgrass for at least 5 years show that the organic-matter content in the upper 6 inches is about 3.5 percent.

"The samples taken represent 15 soil series, widely differing rainfall rates, different slopes and exposures, etc. The ground cover includes coffee, Kudzu-grass pastures, and cultivated land, yet the C/N ratio in the soil is almost always close to 10:1.

"In general it appears clear that the organic-matter and nitrogen content of our soils can be built up rapidly. The maximum levels of those components which can be maintained in the soil is dependent on many factors among which land use is one of the most important. Even on very steep slopes coffee and Kudzu-grass pastures help to maintain relatively high levels of organic matter and nitrogen. Coffee seems to be somewhat the more desirable in this respect."

Brush Control and Pasture Development - H. A. Daniel, Guthrie, Okla.

"Airplanes are being used quite extensively on sand sage and mesquite but the technique has not been as fully developed for the control of oak and other hardwood species for grassland development. Generally the powerful, slow flying airplanes delivering a coarse spray have produced the best coverage. The quantity of acid to produce a satisfactory control of the dense stands of the taller trees has not been definitely determined. Promising results have been obtained by using 4 pounds per acre of alkyl-glycol ester containing equal parts of 2,4-D and 2,4,5-T in diesel oil. Some trials have been made using the ester of the 2,4-D and 2,4,5-T alone.

"Best results have been obtained where 2 pounds of this material were applied in two applications by cross flying the area the first year and then applying additional annual treatments of 1 pound per acre the second and third years after the first treatment. Where this procedure was followed good stands of native grass developed by the third years. The yield was five to eight times more than that produced on adjacent untreated brush land."

Crop Rotations - C. J. Whitfield, Amarillo, Tex.

"Organic-matter samples were taken on part of the rotation plots during the month of December. Two depths were sampled, 0-3 inch and 3-6 inch. Plots sampled included continuous wheat, continuous sorghum, wheat-sorghum-fallow rotation, and wheat-sorghum-fallow-grass rotation. The following table gives the results of this sampling:

Table 1.--Organic-matter Determinations made December 1951

| Cropping practice | Depth of sample (Inches) | Percent organic matter |
|---|---|---|
| Continuous wheat 1942-51 | 0-3 | 2.23 |
| | 3-6 | 1.80 |
| | Av.- 0-6 | 2.02 |
| Continuous sorghum 1942-51 | 0-3 | 1.91 |
| | 3-6 | 1.81 |
| | Av.- 0-6 | 1.86 |
| Grass - 1942-48 Wheat-sorghum-fallow Rotation - 1949-51 | 0-3 | 2.34 |
| | 3-6 | 1.77 |
| | Av.- 0-6 | 2.06 |
| Wheat-sorghum-fallow Rotation - 1942-51 | 0-3 | 1.97 |
| | 3-6 | 1.70 |
| | Av.- 0-6 | 1.84 |

"It can readily be seen that the only major differences are in the 0-3-inch layer. There is about 14 percent more organic matter in the 0-3-inch layer of soil on the continuous wheat as compared to continuous sorghum, and about the same difference, 15 percent, between the wheat-sorghum-fallow-grass and wheat-sorghum-fallow rotation. The effect of grass on the organic matter still shows up after 3 years of cultivation when compared to the plots in rotation without grass. The results also show that continuous cropping to wheat is more conservative of organic matter than crop rotations, except those with grass in the rotation."

Crop Retardation - R. Woodburn, State College, Miss.

"The low of 15 degrees on December 16 and several other days that the temperature was below freezing has retarded the growth of ryegrass. The oats in combination with fescue and wild winter peas have practically all frozen out. The fescue has survived the cold weather but is growing very slowly."

Drought Conditions - H. G. Porterfield, Brownfield, Tex.

"The early fall drought of September and October continued through November and December with no measurable precipitation in either November or December. The topsoil is extremely dry and moderate winds are causing soil movement while high

winds are causing severe damage in many areas. This is the driest 4 months, September 1 to December 31, during the 40 years of record that have been maintained in this area.

"The fall drought condition also made it impossible to plant winter cover crops on cotton land with any chance of a successful stand. One early planting of Cucumonga Brome resulted in a good stand on cotton land. This stand made almost no growth and the plants were completely dead by December 15. Early planted Austrian winter peas as a winter cover following wheat resulted in good stands, but the plots are blowing at the present time and are badly damaged. Wheat on fallow gave good stand but insufficient cover. Balboa rye early planted has made sufficient cover to hold the soil in most cases. Cotton harvested with a power harvester loosened the topsoil and the power harvested plots lost soil before the hand harvested plots. The widespread use of power machinery for cotton harvest while sound from an economical standpoint has increased the wind-erosion hazard.

"This station has been interested in the revegetation of some of the sandier soils of the area that are unsuited for cultivation. The survival of introduced and native grasses reseeded on this land is of interest following a severe drought of over 7 months. From September 27, 1950, to May 10, 1951, only 1.21 inches of precipitation was received compared to the 40-year average of over 7.00 inches. Moisture conditions were good just previous to the beginning of this drought. Well established weeping lovegrass, sand lovegrass, and King Ranch bluestem plants survived 100 percent from a planting made in the spring of 1949. Also there was no killing of blue grama, side-oats grama, little bluestem, sand dropseed, or buffalo grass under native conditions or on reseeded plots. Blue panic planted in July 1950 in 40-inch rows on clean land survived 90 percent. Blue panic planted in August 1950 on rye cover in 12-inch drills had only a 5 percent survivial. King ranch bluestem under the same conditions had a survival of 2 to 5 percent while weeping lovegrass survived 85 to 90 percent and sand lovegrass 100 percent. All stands were excellent before the drought began. The weeping lovegrass made an excellent stand and cover following the 85 to 90 percent survival."

Annual Rainfall and Erosion - B. H. Hendrickson, Watkinsville, Ga.

"Rainfall for 1951 totaled 42.21 inches, and was 7.49 inches below the normal of 49.70 inches. The year was marked by three extended periods of drought--one in late April and May; in August of 6 weeks' duration; and one in late September and October of 3 weeks.

"Rainfall and erosion for the year were approximately 50 percent of the 11-year average for continuous cotton on Class III land. Rotation losses were in about the same ratio, the better rotations still showing superior performance over the poorer ones."

Table 1.--Continuous cotton class III land
7 percent slope, 70-foot slope length runoff plots

| | 1951 | 1940-50 11-yr. Av. |
|---|---|---|
| Rainfall | 42.54" | 51.23" |
| Runoff | 6.77" | 11.15" |
| Runoff % | 15.9% | 21.8% |
| Erosion | 11.85 T/A | 21.26 T/A |

Nozzle Tests for Infiltrometer - G. M. Horner, Pullman, Wash.

"Additional tests were made of nozzles for use in an infiltrometer. The objective is to obtain an application of water at a rate ranging from 1 to 2 inches per hour over an area about 5 or 6 feet square. A nozzle constructed according to the design of Mr. Browning of Region 4 gave the desired intensity of application, but it was difficult to maintain a satisfactorily uniform distribution of water over the different sections of the area. The nozzle was very sensitive to changes in water pressure.

"It appears that the Type-F nozzle, which has been generally used on infiltrometers, may be satisfactory for our needs. A fairly uniform rate of application of water was obtained over a 5-foot square area by mounting the nozzle on a mechanism that imparts a rotary motion to the nozzle. A single nozzle applies water at about 3/4 inch per hour. Multiple nozzles could be used to obtain higher rates. Tests are being continued to determine the optimum water pressure and the inclination the nozzle should be set from the vertical."

## DRAINAGE AND WATER CONTROL DIVISION

Hydrologic Studies - L. L. Harrold, North Appalachian Experimental Watershed, Coshocton, Ohio

"Precipitation of 3.66 inches for the month which was well over normal fell on 18 days, some rain, some snow, some sleet. Ice on the roads made driving hazardous, and ice in the runoff-measuring equipment made the gathering of accurate data on a few days difficult. Runoff from the small watersheds bore no relation to the surface treatment but reflected more of the differences in profile drainage. Runoff from some improved watersheds was greater than that from the poor-practice watersheds.

"Mr. Dreibelbis reports that the conservation-practice corn watershed No. 113 has a lesser amount of soil aggregates throughout the 0- to 4-inch depth than that of No. 118, poor practices as shown in the table below. At the beginning of the experimental comparison 9 years ago, No. 113 was definitely poorer--having been more severely eroded than No. 118. This was one reason for selecting No. 113 for scheduled improvement. In both the good and poor pastures, the volume of fines is much less than in the corn watersheds."

Table 1.--Aggregate analysis of soil from corn watersheds, 1951. Expressed in %.

| Soil depth | Total aggregates | | Total parent materials | | Total aggregates plus parent materials | | Total fines | |
|---|---|---|---|---|---|---|---|---|
| | In rows | Between rows | In rows | Between rows | In rows | Between rows | In rows | Between |
| | Watershed 111, Keene silt loam, sampled 9-5-51 | | | | | | | |
| 0-1 | 25.1 | 24.9 | 30.3 | 33.3 | 55.4 | 58.2 | 44.6 | 41.8 |
| 1-4 | 23.4 | 28.1 | 32.1 | 31.0 | 55.5 | 59.1 | 44.5 | 40.9 |
| 4-7 | 24.1 | 19.5 | 27.5 | 30.2 | 51.6 | 49.7 | 48.4 | 50.3 |
| | Watershed 113, Coshocton silt loam, sampled 9-5-51 | | | | | | | |
| 0-1 | 24.7 | 19.9 | 9.2 | 10.1 | 33.9 | 30.0 | 66.1 | 70.0 |
| 1-4 | 31.9 | 25.3 | 10.3 | 10.7 | 42.2 | 36.0 | 57.8 | 64.0 |
| 4-7 | 39.0 | 32.6 | 12.0 | 11.1 | 51.0 | 43.7 | 49.0 | 56.3 |
| | Watershed 118, Coshocton silt loam, sampled 9-5-51 | | | | | | | |
| 0-1 | 32.8 | 38.7 | 18.1 | 19.5 | 50.9 | 58.2 | 49.1 | 41.8 |
| 1-4 | 41.1 | 42.0 | 23.4 | 19.1 | 64.5 | 61.1 | 35.5 | 38.9 |
| 4-7 | 40.4 | 33.0 | 20.9 | 19.5 | 61.3 | 52.5 | 38.7 | 47.5 |

"The aggregate analysis was also completed on the soils from the pastured watersheds which are sampled at the 0-7-inch depth. The summarized data appear below:"

| Watershed | Soil depth | Total aggregates | Total parent materials | Total aggregates plus parent materials | Total fines |
|---|---|---|---|---|---|
| 129[1] | 0-7 | 40.1 | 42.4 | 82.5 | 17.5 |
| 135[2] | 0-7 | 44.7 | 36.1 | 80.8 | 19.2 |

[1]Alfalfa-ladino-brome.
[2]Poverty grass.

Hydrologic Studies - R. W. Baird, Blacklands Experimental Watershed, Waco, Tex.

"During the month of December there was a total of 0.49 inch of rainfall at Gage No. 69. This small amount of rainfall together with the small amounts during October and November has left all fields quite dry, although there is sufficient moisture to keep winter small grain alive and making some growth. Total rainfall for the year 1951 was 24.71 inches which is about 11 inches below normal. Except for water supply, conditions are slightly better than at a similar period a year ago, but there still is no soil-moisture reserve, and a considerable amount of rainfall will be required before we can be confident of continued crop growth.

"J. B. Pope reports that the light rainfall during the month did not improve the deficient moisture conditions. The Y area still has more moisture than the W area, the difference being attributed mainly to early fall plowing in the Y area. Moisture samples taken on December 6 from the two areas at the designated depths were as follows:

Y-10 Area: 0-6 inches, 27.4 percent; 6-12 inches, 27.4 percent; 12-24 inches, 28.1 percent; 24-36 inches, 28.2 percent; 36-48 inches, 27.8 percent; and 48-60 inches, 28.4 percent.

W-10 Area: 0-6 inches, 26.6 percent; 6-12 inches, 26.2 percent; 12-24 inches, 24.8 percent; 24-36 inches, 22.0 percent; 36-48 inches, 22.0 percent; and 48-60 inches, 23.7 percent."

Hydrologic Studies - J. A. Allis, Central Great Plains Experimental Watershed, Hastings, Nebr.

"On December 14, we received about 1.5 inches of snow containing 0.13 inch of moisture which was the only precipitation received in December. The total rainfall in 1951 was 36.09 inches or a little over 12 inches above the long-time average.

"Although there were approximately 80 drought days in 1951, only 2 occurred in the 6-month growing season, April 1 to September 30, 1951. This is the least number of drought days in any growing season since the beginning of record in Hastings and Red Cloud, Nebr., in 1893. In 1893, they had 88 drought days in the growing season; in 1934, 82 drought days; and in 1940, 79 drought days. In the 59 years of record there has been an average of 33 drought days in the 6-month period.

"The highest annual rainfall was 40.60 inches in 1915 and there have been only 10 years above 30 inches. The lowest rainfall was 11.90 inches in 1936. Twenty-four years have been above normal rainfall and 35 have been below normal.

"It is also interesting to note that from 1900 to 1920, there were 6 years above 30 inches of rainfall and no years below 17.47 inches. In 1920 to 1940 there were 6 years below 17.47 inches and no years above 30 inches.

"December was generally cold and windy. The small snow fall this year was blown off the wheat fields and either lodged along the roads or in the fields with good cover. Some of the snow that fell the last part of November is still on the ground.

"It was noted that at the time the monthly soil-moisture samples were taken the last of December that the frost was down about 30 inches in the wheat ground while on the native grass land it was only about 16 inches deep."

Hydrologic Studies - R. B. Hickok, Lafayette, Ind.

"Mr. W. F. Crain of the Station Staff has compiled the summary of crop yields for the mulch-tillage plots given in the following table:

Table 1.--1950 crop yields, crop-residue management, and mulch-tillage experimental plots

| TREATMENT DESCRIPTION | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Treatment Number | | | | | | | | | |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | | |
| Depth of tillage | | 1 | 3" | 7" | 0-3" | 7" | 7" | 7"[2] | 7"[3] | Significant difference | |
| Depth of residues | | S[4] | S | S | 0-3" | 0-3" | 0-7" | 7" | 0-3 | 5% | 1% |
| THROCKMORTON FARM, LAFAYETTE | | | | | | | | | | | |
| Corn | Bu./A. | 47.3 | 47.1 | 54.9 | 50.0 | 73.8 | 51.4 | 73.0 | 74.2 | 14.9 | 20.3 |
| Beans | Bu./A. | 19.0 | 21.7 | 21.5 | 20.5 | 23.0 | 20.8 | 22.3 | 23.4 | 2.1 | 2.9 |
| Hay | Lbs./A. | 4,085 | 4,148 | 3,596 | 3,950 | 4,066 | 4,158 | 3,610 | 4,032 | 565 | 759 |
| NOBLE COUNTY FARM, ALBION | | | | | | | | | | | |
| Corn | Bu./A. | 81.3 | 84.5 | 84.1 | 85.4 | 112.0 | 89.8 | 99.4 | 107.4 | 13.7 | 19.0 |
| Oats | Bu./A. | 44.8 | 38.4 | 50.6 | 43.6 | 56.0 | 52.4 | 61.2 | 52.2 | 12.9 | 17.6 |

[1]Seeding strip tilled to 7", middles tilled to 3" in cultivation.

[2]Conventionally plowed.

[3]Same as treatment No. 5 except 3" tillage (inversion of turf) preceding fall.

[4]S - Residues retained on the surface.

"It may be noted that treatment Nos. 5 and 8 produced outstanding yields at both locations with substantial advantage of No. 5 over No. 8 at Albion. Corn yields were found to correlate closely with stands for the various treatments. It is considered that the stands were affected chiefly by mechanical aspects of the planting and to a lesser degree the cultivation, and that the stands and yields were not materially affected by biotic conditions dependent upon the treatments. Fertilization practices were designed to eliminate nutrient limitations. Specific fertilization requirements and the related economic feasibility of particular types of mulch culture for corn will remain to be determined when the mechanical

problems are solved. Very encouraging progress is being made in the latter."

Hydrologic Studies - G. A. Crabb, Jr., East Lansing, Mich.

"Snowfall for the month totaled 27.8 inches, which is the second largest December snowfall on record. The largest was 29.3 inches in December 1929."

Farm Pond Studies - T. W. Edminster, Blacksburg, Va.

"Mr. Holtan reports that soil samples for three ponds on the Eastern Shore of Virginia and from the Sportsmans' Club pond at Weirton, W. Va., were tested over a 20-day period. These samples were submitted to a 30-foot head of water.

"The samples from West Virginia were mostly silt and aggregated clay. Salt, sand, and powdered bentonite additions with subsequent compaction did not give satisfactory results. When 'pea size' standard Volclay Bentonite was mixed thoroughly with 5 inches of soil and the mixture compacted at optimum moisture, a completely impervious soil was achieved. No percolate was observed during the 20 days of testing under a 30-foot head of water.

"These results were reported to the SCS State Office of West Virginia. A more economical seal may be feasible using local clay, but as yet we have not received a sample from West Virginia and it was felt that they may want to get started now during wet conditions even though the cost would be greater.

"Results indicate that the rounded sand from Eastern Shore is still not well bonded by the clay which was added. The samples to which HaCl was added are less pervious than the others, but none of these samples are water tight."

Runoff Studies - N. E. Minshall, Madison, Wis.

"Precipitation, all in the form of snow, at Fennimore for the month totaled 0.85 inch which brings the total for the year to 46 inches or about 50 percent above the normal. This is the maximum amount recorded since the studies were established in 1938. The records at nearby Lancaster show that this amount has been exceeded only once since 1891. Temperatures varied from a minimum of -17 degrees on the 23d to a maximum of 62 degrees on the 3d, with a mean for the month of 18 degrees, which is about 4 degrees below normal.

"The Project Supervisor presented a paper at the Amer. Soc. Agri. Engin. annual meeting in Chicago on 'The Effect of Conservation Practices on Watershed Yields from the Flood Control Standpoint.'"

Hydraulic Studies - F. W. Blaisdell, Minneapolis, Minn.

"Mr. Donnelly continued his experiments on the straight drop spillway. End sills that were low in the center were tried in an effort to let more water pass down the center of the downstream channel and thereby reduce the bank erosion. It was not possible to detect any significant improvement in the scour pattern. Mr. Donnelly has finally reached a conclusion, after considerable effort to find some other solution, that the tailwater level must be raised for the higher heads over the spillway in order to prevent excessive bank scour. Tests are now being made to determine the tailwater necessary to give good scour conditions using floor blocks and longitudinal sills $0.8d_c$ high and an end sill $0.4d_c$ high."

Hydraulic Studies - W. O. Ree, Stillwater, Okla.

"The check tests on the pipe-outlet spillway with the 8-foot drop inlet riser were completed this month. Previous tests on this structure had given some erratic results. Preliminary analysis of the check runs indicate that better data have been secured. A complete report on the pipe-outlet experiment is now being prepared.

"A calibration was made of the modified 4-foot Parshall flume used for the pipe-outlet experiments. This calibration showed the flume rating to agree with that given by Parshall's formula for this type of flume. It was first thought that the unsymmetrical approach to the flume might disturb the rating. Since the flume was the primary discharge rate measuring device for the steady flow tests on the pipe outlet it was necessary to check this question. The close agreement of the ratings was gratifying.

"Analysis of the data from the runoff studies was started. Infiltration capacity curves were derived for two of the watersheds using the method outlined by Schiff in SCS-TP-90. Also the detention storage-runoff relationships were determined for these watersheds.

"One of the better determinations resulted in the relationship $q = 2.5\ D_S^{1.62}$ where $q$ is runoff rate in inches per hour and $D_S$ is detention storage in inches. This is for a 210-acre watershed with a native grass cover of a range condition averaging good. The slopes are 4 percent for 55 percent of the area, 10 percent on 35 percent of the area, and 1 percent on the balance.

"The preliminary results will be reported when more of the storms have been analyzed. Runoff coefficients for the rational formula are also being determined. These have varied considerably ranging from 0.13 to 0.71 for the 210-acre watershed just described."

Drainage Studies - J. C. Stephens, West Palm Beach, Fla.

"Efficiency tests were run on two types of pumping plants. These plants were selected because they were powered by electric motors which made it possible to obtain an accurate measurement of the power input by using the hook-on type watt-hour meter which compensates for phase factors and shows actual power used.

"The first plant tested was an irrigation pump used to irrigate pasture lands at Forman's Dairy, west of Ft. Lauderdale, Fla. This pump is a standard axial-flow screw type, made by the Couch Manufacturing Company, Grant, Fla. Measurements were made by means of a pitot tube. It was found necessary, due to the relatively thin shell of the pump-discharge pipe, to modify the standard pitot tube fitting and to weld a short 1/2 inch nipple onto the pump casing to accommodate the modified fitting. The 'Ten Point Method' was used and each set of measurements included one traverse made in an upward direction and one in the downward direction. One set of measurements was made while the pump operated with the automatic flap gate attached to the end of the discharge pipe, in normal position, and another set made without the automatic cut-off gate. All measurements differed less than 1 percent, and it was concluded that the effect of the flap gate on decreasing discharge was negligible. The over-all efficiency of this pumping plant was found to be 58 percent.

"The other test was made at the booster lift station, operated by the Lake Worth Drainage District, on Range Line Canal along State Road 7, approximately 7 miles west of Delray Beach, Fla. This plant consists of a 10,000 gpm modified centrifugal panel-type pump, manufactured by the Morgan Pump Co., Delray Beach, Fla. It is powered by a 75 h. p. electric motor. Discharge was obtained by taking the average of current-meter measurements made in the canal a short distance above and below the pumping site. Both measurements differed by less than 4 percent which indicated little leak-back through the pumping structure or seepage inflow between measuring stations. The efficiency of this installation was found to be 14 percent. This efficiency corroborates earlier tests made on gasoline-driven pumps of this type showing that the modified centrifugal pump is relatively inefficient at the low heads usually pumped against in the Everglades. Below is a summary of the data obtained on each test:

Forman's Dairy

Test made: 11/14/51
Type of pump: 10,000 gpm Couch axial-flow screw type pump operated by 15 h. p. electric motor - V-belt drive.
Average head during test: 3.61 feet.
Average velocity through discharge pipe: 7.3 ft./sec.
Discharge: 22.86 c. f. s. or 10,260 gpm.
Theoretical H. P. requirement: (100% efficiency): 9.35 h. p.
Measured input to pumping system: 12.1 k. w. or 16.2 h. p.
Pump speed: 610 r. p. m.
Efficiency of pumping installation: 58 percent.

Range Line Canal

Test made: 11/14/51
Type of pump: Morgan modified centrifugal panel type pump powered by 75 h. p. electric motor - V-belt drive.
Average head during test: 2.00 feet.
Discharge: 32.82 c. f. s. or 14,740 gpm.
Theoretical H. P. Requirement: (100% efficiency): 7.45 h. p.
Measured input to pumping system: 40.3 k. w. or 54.0 h. p.
Pump speed: 340 rpm.
Efficiency of pumping installation: 14 percent.

"Last year this project, and the Everglades Experiment Station, were requested by the Central and Southern Florida Flood Control District to make investigations to determine suitable types of vegetative covering for erosion control on the levees constructed under the Federal Flood Control Program. Approximately 18 months ago 118 spot plantings of different grasses were made on Levee 35-A; six 1/6-acre plots at selected sites on various levees were seeded to Pensacola Bahia grass; and a portion of Levee L-8 was seeded to Bermuda grass under contract and planted shortly after construction. Recent observations indicate that none of the plantings so far observed are entirely satisfactory for protection of the levees. Of those observed, para grass would probably give the best erosion protection from rainfall and also prevent erosion from wind and wave action during hurricanes. However, para grass is a water-loving plant and in a few years would encroach upon the drainage canals parallel to the levees and present a maintenance problem of major proportions.

"In searching for a type of vegetation to fulfill the requirements, it was decided to experiment with kudzu since it furnishes such excellent erosion protection for landfills in the more temperate climes north of this area and yet is not liable to present a problem in maintenance of the drainage ways because it is not tolerant to high water tables. To determine whether or not this plant would grow under the soil and climatic conditions prevailing in this area, a search was made to discover any kudzu now growing and with the aid of the Homestead Project personnel, a few patches of the common variety of kudzu, which apparently had become acclimated to this climate, were found growing in the better drained rockdale soils around Homestead, Fla. Mr. R. Y. Bailey, Regional Research Representative, was invited to visit the area and after a tour of the proposed planting sites along the various levees, recommended that test plantings be made just under the crown of the levees using Japanese seed for trial of the common kudzu and Puerto Rican seed for the tropical variety of kudzu. Orders have been placed for 50 pounds of each kind of seed and plans have been made to begin plantings in early March.

"We wrote to Dr. W. F. Libby, of the Institute for Nuclear Studies at the University of Chicago, inquiring in regard to the use of his method which determines the age of organic remains by measuring the rate of disintegration of radioactive Carbon-14 for dating the origin of the peat soils in the Everglades. Dr. Libby replied that they were making only a limited number of radiocarbon measurements during this next year and could measure only materials which are of established interest. He stated that Dr. James Thorp of the Division of Soil Survey, Lincoln, Nebr., and Dr. Richard Foster Flint of Yale University passed on all applications made to the Nuclear Institute for the determination of age of peat soils.

"Dr. Thorp was interested enough to visit the Everglades area while on vacation during December, and as a result of his observations during this trip, recommended to Drs. Flint and Libby that samples of the Everglades peats be among those accepted for age evaluations. Dr. Thorp stated: 'I should think it would be of considerable interest from a geologic viewpoint to know the rate at which peat deposits can accumulate and the age relationships of the beds of southern Florida to peat deposits in other parts of the world. Of course, the Central and Southern Florida District and the Soil Conservation Service are interested primarily to compare the time required for the Everglades peat to accumulate with theoretical time required for it to be destroyed by oxidation under conditions of artificial drainage and cultivation. This has a very important bearing on the length of time we can expect the Everglades to be an area of high agricultural production. Of course, even at present, only a relatively small part of the Everglades is suitable for cultivation, but this small part does produce a great deal of food.'"

"Samples have been collected by Mr. Craig at the Everglades Experiment Station, in connection with samples obtained in making density determinations on the subsidence studies, from the surface to the underlying limestone rock, at 6-inch intervals from the bottom to the top, and will be submitted to Dr. Libby if our application for age determinations of these soils is accepted."

Drainage Studies - E. G. Diseker, Raleigh, N. Car.

"On November 19 and 20, the writer, together with W. W. Stevens, State Soil Scientist, Penn Moore, District Conservationist, Dick Bailey, Engineer, Roy Beck, Technician, all of the Soil Conservation Service, and C. F. Lindley of Oriental, N. Car., inspected a portion of the organic soils known as the 'open grounds' located about 15 miles northeast of Beaufort. This area is on an island and covers several thousand acres. Approximately 4,100 acres of the area belongs to Miss

Georgiana P. Yeatman. Many years ago a land development company from New York installed ditches 1/4 quarter mile apart with headland ditches about 1 mile apart and major canals about 1 mile apart. A number of buildings were constructed and a settlement was established, but was shortlived. Farming was not a success in this area.

"The above-mentioned personnel inspected a portion of the area with the view of determining if it would be feasible to improve the drainage system and establish pasture for cattle production. This undrained area in its present state is worthless for agricultural purposes. Probably its greatest value is of interest to the (poaching) deer hunters. The muck soil varies in depth from about 2 to 5 feet, depending largely on subsidence and previous fires. Vegetation consists of sage grass, brush, and scattered pines.

"It was concluded that a large part of the area could be used for pasture, provided the existing drainage system was cleaned out and additional ditches were installed midway between the 1/4-mile ditches. Proper liming and fertilization would be necessary. Mr. Beck, the local soil conservationist, had previously completed some engineering surveys and has proposed a farm plan for about 1,100 acres. However, in a recent conversation with Mr. Lindley, who is promoting this enterprise, the writer was advised that the reclaiming of over 2,000 acres is under consideration."

Muck Drainage Studies - R. B. Hickok, Lafayette, Ind.

"Mr. H. A. Jongedyke has summarized the results of some soil-moisture studies made on the drainage experimental plots (Walkerton, Ind.) during 1949 and 1950, which illustrate the unusual capacity of these soils (in comparison with mineral soils) to supply moisture from a water table to balance consumption, and indicate limited need for above ground irrigation where the water-table levels are maintained within 2 to 4 feet of the ground surface.

"Soil moisture was measured to determine whether it was limiting for a crop after a prolonged period without rain. Results are summarized in the following tables:

Table 1.--Moisture relations of muck soil profiles with three depths[1] of controlled drainage, 1949-50, Purdue Muck Experiment Farm, Walkerton, Ind.

Percentages of moisture by volume

| Depth | Saturation | | | Field capacity[2] | | | Moisture content, field conditions[3] | | |
|---|---|---|---|---|---|---|---|---|---|
| | Plot No. | | | Plot No. | | | Plot No. | | |
| | 4 | 7 | 8 | 4 | 7 | 8 | 4 | 7 | 8 |
| Dust mulch (1-2" thick) | - | - | - | - | - | - | Almost none | 10 | 10 |
| 0-7" Except dust mulch | 75 | 76 | 75 | 67 | 67 | 63 | 69 | 64 | 53 |
| 7-12" | 80 | 83 | 85 | 77 | 77 | 76 | 72 | 69 | 58 |
| 12-18" | 89 | 84 | 84 | 85 | 79 | 79 | At or near saturation | 74 | 66 |
| 18-25" | | 88 | 87 | | 84 | 82 | | 83 | 76 |
| 25-30" | | 90 | 88 | | 86 | 85 | | | |
| 30-40" | | 91 | 90 | | 85 | 85 | | | |

Footnotes for the above table appear on the next page.

[1]Plot average water-table depths 1944-50: Plot 4, 1.3'; Plot 7, 2.1'; Plot 8, 3.3'. Water tables at 1.2', 2.1', and 3.6' respectively when moisture was measured under field conditions.

[2]Field capacity determined in field or estimated from moisture content after water table is lowered.

[3]Moisture samples from soil in potatoes after period 1 - 2 weeks no rain.

Table 2.--Key pF values of muck soil and peat,[1] controlled drainage plots Purdue Muck Experiment Farm, Walterton, Ind.

| | % moisture by volume | |
|---|---|---|
| pF | Muck | Raw peat |
| 0.0 | 74-86 (Saturation) | 91 |
| 1.7 | 62-76 (field capacity) | 81 |
| 2.0 | 56-74 | 77 |
| 3.4 | 35-39 | 29 |
| 4.15 | 29 (wilting point) | |
| 7.0 | 0 | |

[1]Determined in 1950 and 1951.

"Because of the apparent movement by vapor and capillary action from the water table, moisture, except in the surface dust mulch, was not limiting." E. M. Anderson in reporting variation in water table and soil-moisture content of peat soil due to growth of lettuce, did not report any pF values above 2.9 at 6 inches depth after a dry period. (Am. Soc. Hort. Sci. Proc. 37: 693-696). This corroborates these measurements made on the muck-drainage plots at Walkerton. Except for local spots the pF was generally no higher than 2.8 in the surface 3" - 6" of the driest of all plots (water table 43" deep).

"Water is conducted upward fairly rapidly by capillary tension. The closer the water table, the greater the moisture content of the soil as a result of capillary conductivity. (Capillary water keeps muck soil on the experiment plots wet at the surface where the water table is as shallow as 15 inches below the surface). M. B. Russell in his paper 'Predicting Changes in Water-Table Elevation in Peat Land,' Agricultural Engin. 26: 292. 1945, shows an idealized relationship between water table and soil moisture as influenced by capillary action. Capillary and vapor movement of water are quite apparent in muck soil-moisture distribution (see preceding table).

"Subsidence is greater with little or no benefit from increased crop growth when the water table is deeper than 2 feet. After the soil structure has been developed by deeper drainage for an initial period (water table at about 4 ft.), a water table at about 2 feet may be readily maintained with 4 to 6-foot deep tile lines by controlled outflow and subirrigation.

"It may be concluded that for many muck soils, subirrigation provided by controlled drainage makes above-ground irrigation systems unnecessary for most optimum crop growth, except as an aid to germination or for high-priced crops with specific requirements for sprinkler irrigation. Shallow organic soils or muck and peat soils underlain by strata limiting capillary movement and making water-table

[1]Soil moisture was measuredin upper 1.5 in potato area away from influence of tile.

control impossible, may need above-ground irrigation for optimum crop growth."

Drainage Studies - T. W. Edminster, Blacksburg, Va.

"Mr. Walker reports that a topographic survey was made of the cut of land in which draw-down Site 8 is located on the Norfolk Prison Farm. From this survey, the specific details for grading the area for better drainage are being formulated.

"Mr. Inge, Farm Superintendent, stated that his harvest of corn and soybeans was not complete; therefore, he could not spare the necessary labor and equipment for grading the area before January 1, 1952. Plans were made to do the job as soon as the soil becomes dry enough to work after this month.

"Mr. Walker presented a paper entitled 'Depth and Spacing for Drain Laterals as Computed from Core Sample Permeability Measurements' before the Soil and Water Conservation Section of the Amer. Soc. Agr. Engin. in Chicago, Ill., December 19. He also appeared on a panel discussion summarizing various aspects of drainage research being conducted at present.

"While not a member, he sat in on the meetings of the Drainage Committee. Although this committee discussed several topics, the main item on its agenda was to discuss the report on the Tile Depth and Spacing Subcommittee on Specifications for Design and Construction of Tile Drains. After much discussion, it was decided that the objective of the report should be to present recommendations of standards to be met rather than standards that must be attained. The material was then returned to the subcommittee for revisement."

Sedimentation Studies - L. M. Glymph, Jr., Lincoln, Nebr.

"A study was made of the relationship of suspended-sediment load to water discharge at three stations on the Big Horn River in Wyoming and Montana. The stations and the drainage area above them were: Thermopolis, Wyo., drainage area 8,080 square miles; Kane, Wyo., drainage area 15,900 square miles; and St. Xavier, Mont., drainage area 19,600 square miles.

"Available records of annual suspended-sediment (in tons) passing these stations were plotted as ordinates on log-log paper against annual water discharge (in acre-feet). These plottings of the data on hand showed reasonably consistent relationships and equations for each of the lines were computed by the method of least squares. The resulting curves were defined by an equation of the form:

$$S = cR^x$$

Where S = Annual suspended sediment (tons)
R = Annual runoff (acre-feet)
c = Coefficient
x = Exponent

Equations derived for the three stations were:

| | |
|---|---|
| Thermopolis | $S = 10.94 \times 10^{-10} \times Q^{2.62}$ |
| Kane | $S = 38.47 \times 10^{-8} \times Q^{2.20}$ |
| St. Xavier | $S = 32.93 \times 10^{-15} \times Q^{3.25}$ |

"The slope of these curves are somewhat steeper than any others showing the same variables which have come to the attention of the writer. The rate of increase in sediment load with an increase in discharge appears to be higher than

that shown by most records. Quality of records may possibly be one of the explanations for this rapid response in sediment load to discharge. The data used in the analysis were collected a number of years ago, before the more recent developments in suspended sediment samplers and sampling techniques.

"On the other hand, it is not unreasonable to suppose that a rapid increase in sediment load as the discharge increases could be an expression of stream channel and other watershed characteristics. In a drainage area where a large percentage of the sediment load is derived from eroding stream systems and gullies, uncommonly rapid increase in sediment concentrations with increased stages may be the rule and perhaps should be expected. Additional study will be given to these and related data to see if a more satisfactory and conclusive explanation of the relationships can be found."

Sedimentation Studies - R. Woodburn, State College, Miss.

"Further studies were made on the tentative reservoir sediment formulae. Calculations of sediment were made for several typical cases by the four formulae derived and by Mr. Gottschalk's Little Sioux study formula. Formula 3 is recommended for use until further refinements may be added. These calculations are shown below:"

Case A W = 500 acres
T = 5 yrs.
E = 45 tons/acre/yr.

--- Low C of 100 ---

| | Reservoir sediment Tons | Total gross erosion Tons | Res. sed. divided by gross erosion Percent |
|---|---|---|---|
| Formula 1 | 29,250 | 112,500 | 26 |
| Formula 2 | 38,100 | " | 33.8 |
| Formula 3 | 37,300 | " | 33.1 |
| Formula 4 | 48,300 | " | 42.9 |
| G | 98,000 | " | 87 |
| ---Medium C of 300--- | | | |
| Formula 1 | 51,850 | 112,500 | 46.1 |
| 2 | 38,100 | " | 33.8 |
| 3 | 54,100 | " | 48 |
| 4 | 48,300 | " | 42.9 |
| G | 147,400 | " | 131 |
| ---High C of 600--- | | | |
| Formula 1 | 80,400 | 112,500 | 71.4 |
| 2 | 38,100 | " | 33.8 |
| 3 | 68,600 | " | 60.9 |
| 4 | 48,300 | " | 42.9 |
| G | 190,600 | " | 169.2 |

(1) $S = \frac{1}{2.235} W^{.8139} T^{.2973} E^{.6629} C^{.6294}$ (Raw data)

(2) $S = 11.974\ W^{.8168} T^{.4802} E^{.5825}$ (Raw data)

(3) $S = \frac{1}{2.578} W^{.8957} T^{.6573} E^{.8573} C^{.3423}$ (Adjusted data)

(4) $S = 2.130\ W^{.9151} T^{.7329} E^{.8303}$ (Adjusted data)

G $S = .785\ W^{.7664} T^{.7867} E^{1.0545} C^{.3701}$ (Little Sioux Study)

Case B W = 2,000 acres
T = 5 yrs.
E = 45 tons/acre/yr.

--- Low C of 100---

| | Reservoir sediment Tons | Total gross erosion Tons | Res. sed. divided by gross erosion Percent |
|---|---|---|---|
| Formula 1 | 88,800 | 450,000 | 19.7 |
| 2 | 118,000 | " | 26.2 |
| 3 | 128,800 | " | 28.6 |
| 4 | 171,000 | " | 38 |
| G | 286,000 | " | 63.5 |

---Medium C of 300---

| | | | |
|---|---|---|---|
| Formula 1 | 159,200 | 450,000 | 35.4 |
| 2 | 118,000 | " | 26.2 |
| 3 | 187,000 | " | 41.6 |
| 4 | 171,000 | " | 38 |
| G | 430,000 | " | 95.5 |

---High C of 600---

| | | | |
|---|---|---|---|
| Formula 1 | 246,500 | 450,000 | 54.8 |
| 2 | 118,000 | " | 26.2 |
| 3 | 237,000 | " | 52.7 |
| 4 | 171,000 | " | 38 |
| G | 556,000 | " | 123.5 |

IRRIGATION ENGINEERING AND WATER CONSERVATION DIVISION

So-Called Piping Conditions Near Picacho Peak, Pinal County, Ariz. - K. Harris, Phoenix, Ariz.

"On December 11, 1951, Fletcher, Chanler, Harris, and Peterson of Research of the Soil Conservation Service made an investigation of the so-called piping conditions near Picacho Peak, Ariz. This area is located in T8S R9E.

"The length of the piping area runs approximately 1 mile east of the railroad and about 1/4 mile west of the railroad. No evidence of piping was found beyond these points. This whole area was inspected on foot, and investigations made all along the way.

"All the conditions necessary for piping were found in this area. Innumerable washes throughout the area east of the railroad provide the outlets necessary for piping. The area to the west of the railroad sloped toward the railroad and on the washes, furnishing a necessary outlet for the water.

"Overlying the piping area there is an impervious topsoil which acts as a roof. This results in an abundance of water which drains from these flats into the many pipes and washes.

"The soil profile shows two or three stratified shallow layers of silty clay separated by more permeable coarse silt layers. At about 48 inches, a thicker silty clay layer is encountered. Water will move through the coarse silt layers at a much faster rate than through the silty clay layers. Because of this stratification, there are two or three different depths of piping.

"Uhland core samples indicate that the percolation rate of the layer above the silty clay layer is about seven times as fast as is the rate through the silty clay layer. There is also quite an increase in the apparent specific gravity of the silty clay layer.

"There are many pits throughout the general area that have developed because conditions are presently conducive to piping, i. e., water has ponded, and then due to rodent holes or cracks developing, has moved rapidly into the very permeable and erodible subsoil. This underground strata drains into one of the many washes located in the area.

"There is a long pipe running roughly in an east-west direction. This pipe is over a mile long, and crosses several washes, which furnishes an outlet for the water. There is considerable question as to how this long pipe started, but at the present time, it acts as a true pipe. This pipe which roughly follows the contour across the drainage, intercepts all water that falls on or flows across the area. Most of the rain that falls on this area with its puddled topsoil runs off into this long pipe. With the outlets and the soil conditions that are present, all requirements necessary for pipes to form have been met."

Surface Irrigation Studies - W. D. Criddle, Boise, Idaho

"Irrigation data obtained at the various irrigation schools, demonstrations, and other individual irrigation trials for the Western States were compiled.

"The furrow-irrigation data consisted of crop, soil texture, slope of furrow, root zone depth, total readily available moisture capacity of root zone, moisture to be replaced by irrigation, furrow spacing, final intake rate from furrow, maximum allowable non-erosive stream, and maximum allowable length of furrow.

"The border irrigation data consisted of crop, soil texture, slope of furrow, root zone depth, total readily available moisture, moisture to be replaced by irrigation, width of border strip, length of border strip, most desirable irrigation stream, unit irrigation stream, height of border dikes, average intake rate from concentric ring test, final intake rate from concentric ring test.

"The compilation gives a factual basis for making recommendations on lengths of furrows and size of non-erosive furrow stream for various slopes and soil textures on furrow-irrigation sites. It will also give us a factual basis for making recommendations on size of border streams and lengths of border on various soil types, slopes, and for different depths of irrigation."

Drainage Investigations, Gem County - W. D. Criddle, Boise, Idaho

"George B. Bradshaw reports that piezometric observations on the influence of open drains in various types of Gem County soils are being continued.

"Observations to date indicate that the isolated drainage problems existing north of the Payette River are generally due to soil and permeability changes. These drainage problems occur where a barrier of heavier-textured soil impedes the normal movement of excess irrigation or seepage ground water.

"Seven-foot-deep open interception drains are being recommended on several of these isolatedwater-logged areas. The drains are being located with respect to the permeability of the soils and the break in slope to obtain the maximum drainage effect."

Dairy Pasture Irrigation - F. B. Hamilton, Lincoln, Nebr.

"A project on dairy pasture irrigation was initiated this year at Lincoln, Nebr., with our regular cooperators and the Dairy Department. We were assigned the water-management aspect of the experiment. The other aspects of the study include long-time effects on animal production and health of a management system employing the maximum of good pasturage. The pasture consisted of three plots of 2 acres each planted to a mixture of brome grass, alfalfa, and ladino clover.

"The basis for water management was the application of the Blaney-Criddle Formula for consumptive use to the determination of the amount of water required at each irrigation. A 16-day rotation was set up for the grazing management. The problem then becomes one of determining the amount of water to apply at the time the plot is available for irrigation. Computations were made of the water use during the previous 16 days on the basis of daily mean temperatures and daylight hours. This amount was compared to rainfall during the period. If a deficit in moisture occurred, the difference was made up by irrigation. Soil-moisture samples were taken before and after irrigation as a check on the procedure. Table 1 shows the comparison between the predicted use per day during the various periods and the use per day as measured by soil-moisture samples.

Table 1.--Predicted and measured use of water by dairy pastures, Lincoln, Nebr. 1951

| Plot | Date | Average mean temperature °F | Predicted use in/day | Measured use in/day |
|---|---|---|---|---|
| 1 | July 20-July 30 | 76.1 | 0.229 | 0.194 |
| | July 31-Aug. 17 | 68.6 | .197 | .185 |
| | Aug. 22-Nov. 8* | 56.5 | .101 | .089 |
| 2 | July 18-July 25 | 77.0 | 0.224 | 0.287 |
| | July 28-Aug. 13 | 74.4 | .205 | .198 |
| | Aug. 15-Aug. 31 | 72.3 | .196 | .176 |
| | Sept. 5-Nov. 12* | 53.2 | .119 | .057 |
| 3 | July 22-Aug. 9 | 75.5 | 0.212 | 0.259 |
| | Aug. 12-Nov. 15* | 57.2 | .134 | .102 |

*Included period after frost.

"The difference between predicted and measured use is statistically non-significant. The number of observations is too limited for conclusions but the correlation obtained indicates that this method of predicting water requirement of a given crop on an individual field basis holds some promise of success."

Irrigation Studies - D. W. Bloodgood, Austin, Tex.

"During the 1951 irrigation season for rice, the amount of water available at the J. D. Wood farm of 410 acres near Brookshire (pumped water from wells) was 3.04 acre-feet per acre. At the 75-acre field at the Beaumont Station (canal water) the water available for rice was 3.15 acre-feet per acre. At the Tom Babb farm of 767 acres near Edna (river and well water), the amount of water available for rice was 4.08 acre-feet per acre. The Wood farm produced an average yield of 17 barrels per acre; the Beaumont Station, 15.69 barrels per acre; and Tom Babb farm, 10.4 barrels per acre."

Canal-Lining Studies - C. W. Lauritzen and Warren W. Rasmussen, Logan, Utah

"Semi-annual inspection low cost canal lining samples from our compost tank revealed:

1. Butyl rubber had undergone no noticeable deterioration in 4 years time.

2. The cotton, rayon, and jute in samples of Butyl coated cotton drill, rayon, and jute was completely disintegrated.

3. The nylon and fiberglas in samples of Butyl coated nylon and fiberglas had deteriorated little, if any, in 4 years' time.

4. Significant deterioration was noted in samples of prefabricated asphaltic membrane of the paper backed type after 6 months' time and further deteioration after 12 months.

5. Deterioration of the fiberglas reinforced asphaltic membrane after 1 year's time was limited to hardening or decreased flexibility.

6. After 5 months there was some evidence of deterioration in samples of prefabricated asphalt impregnated asbestos mat ditch lining material."

Irrigation Studies - N. P. Swanson, Amarillo, Tex.

"A relatively high consumptive use was found for winter wheat in 1950-51. No explanation other than a dry season with abnormal wind movement can be offered. (See table 1.)

Table 1.--Consumptive use of winter wheat - 1951
Irrigation studies - Amarillo Conservation Experiment Station

| Treatment (preplanting irrigations were not required) | Soil moisture decrease from planting to harvest | Rainfall from planting to harvest | Total water applied by irrigation | Total water requirement | Yield* |
|---|---|---|---|---|---|
| | Inches | Inches | Inches | Inches | Bu/ac. |
| Three irrigations December 15 April 6 May 4 | 7.43 | 11.90 | 12.0 | 31.33 | 16.0 |
| Two irrigations December 15 April 6 | 6.30 | 11.90 | 8.0 | 26.20 | 12.05 |
| One irrigation December 15 | 6.80 | 11.90 | 4.0 | 22.70 | 8.0 |
| No irrigation | 6.64 | 11.90 | 0 | 18.54 | 4.8 |

*All of the plots were damaged by hail on two dates. Damage was 50 percent or more.

4.85 inches of rainfall on May 15 and 16 required some draining of the plots. No other water was lost by runoff. May rainfall totaled 6.25 inches.

"Moisture use from depths of 5 and 6 feet were found with both irrigated wheat and irrigated grain sorghums in 1951. The total moisture withdrawn from the 5th and 6th foot were generally not greater than the utilization of moisture from the 4th foot. Litle or no moisture was added by rainfall or irrigation below 36 inches, after planting."

Soil-Moisture Extraction by Wheat - S. J. Mech, Prosser, Wash.

"Data on the portion of the total water use that came from the different soil depths are presented below for the 1951 wheat. Moisture extraction is based on soil-moisture determinations made 3 days after one irrigation was stopped and 1 day

before the next irrigation was begun. Any precipitation occurring between these dates was included as use from the 1st foot and gave the 'including rain' results. The influence of 1.83 inches of rain changes the pattern to some extent. The occurrence of a larger amount of rain, as found in some sections of the country, would emphasize the 1st foot to an even greater extent and decrease the other depths proportionately. This would provide a considerably different pattern.

Percent of Total Use

| Depth in feet | Wet | Medium | Dry | Average |
|---|---|---|---|---|
| | Precipitation not included | | | |
| 0 - 1 | 25.7 | 28.9 | 29.8 | 28.1 |
| 1 - 2 | 33.7 | 34.3 | 33.4 | 33.8 |
| 2 - 3 | 26.0 | 22.7 | 23.5 | 24.1 |
| 3 - 4 | 14.6 | 14.1 | 13.3 | 14.0 |
| | Including 1.83 inches of rain | | | |
| 0 - 1 | 35.7 | 39.2 | 35.2 | 36.7 |
| 1 - 2 | 29.2 | 29.3 | 30.8 | 29.8 |
| 2 - 3 | 22.5 | 19.4 | 21.7 | 21.2 |
| 3 - 4 | 12.6 | 12.1 | 12.2 | 12.3 |

"These data show no practical difference in the extraction pattern which can be attributed to the wet, medium, or dry soil-moisture treatment.

"Detail analysis was also made of the extraction phenomena at different times during the growing season. It showed that for the period from emergence to the end of 'stooling-out' stage (approximately March 28 - May 5), there was no water removed from the 4th foot. The first foot furnished about 1/2 of the total amount used during this period. About 1/3 came from the second, and about 1/6 from the third.

"The soil-moisture extraction from each foot of depth was practically constant during the period from stem development until harvest. Since the total water use from 'emergence' through 'stooling' was relatively small, the use pattern after this period is only slightly different from that reported for the season's total. The extraction during the 'stemming to maturity' period (approximately May 7 - July 10) is presented below:

Soil-moisture Extraction in Percent of Total Use.
Precipitation Included.

| Depth in feet | Emergence through stooling | Stemming-out through maturity | Season's total |
|---|---|---|---|
| 0 - 1 | 50 | 33.1 | 36.7 |
| 1 - 2 | 34 | 30.7 | 29.8 |
| 2 - 3 | 16 | 22.3 | 21.2 |
| 3 - 4 | 0 | 13.8 | 12.3 |

Extraction by Different Crops - S. J. Mech, Prosser, Wash.

"The following table shows the soil-moisture extraction pattern for the crops in our 7-year rotation. The similarity in this pattern is quite striking even though the crops included are generally considered to have widely different types of root systems:

Percent of Total Water Use Taken from Different Depths of a 4-ft. Root Zone. Rainfall Included.

| Depth in feet | Alfalfa | Potatoes | Sugar Beets | Corn | Wheat |
|---|---|---|---|---|---|
| 0 - 1 | 35.8 | 36.8 | 33.8 | 42.1 | 36.7 |
| 1 - 2 | 29.5 | 30.5 | 31.7 | 28.2 | 29.8 |
| 2 - 3 | 22.1 | 20.7 | 21.7 | 19.1 | 21.2 |
| 3 - 4 | 12.6 | 12.0 | 12.8 | 10.6 | 12.3 |

"That the extraction patterns for these different crops are so similar raises the question as to whether the crop or the soil is the dominant factor in the development of these patterns. Data from other projects with different soil type have shown radically different patterns.

"A certain soil-moisture extraction pattern does not necessarily mean that it represents the amount of roots found at the different depths. Examination of numerous plants has shown that wheat has the bulk of its roots in the top 6 inches of soil, but apparently these are predominately for mechanical support and do not furnish their proportionate share of water. The smaller mass of roots extending below this depth furnish the greatest part of the water used by the plant. It is suspected that other crops have similar characteristics and that the soil-moisture extraction pattern merely shows the extent to which roots penetrate. It shows almost nothing about how much root material is present at the different depths."

2/20/52